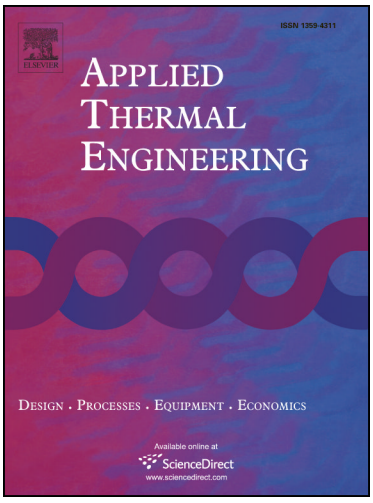

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Study on multi-cycle coupling mechanism of hypersonic precooled combined cycle engine

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Abstract: Propulsion system is a crucial issue of hypersonic civil aviation. Precooled engine shows attractive advantages in high flight Mach numbers, and the hypersonic precooled combined cycle engine (HPCCE) is one of the most potential plans. Multi-cycle coupling is the most remarkable feature of HPCCE, reflected by the large-scale frequent energy exchange among subsystems, i.e. opened cycle, closed cycle and propellant system, and the interaction between the designs for different working conditions. The mechanism is studied through engine cycle analysis with enthalpy-entropy relations. Quantitative discussion on major design parameters based on a component level simulation model shows the trends of inter-impact among subsystems and parameters, and sketches the multi-cycle mechanism and energy transfer relations in detail. Vital issues that should be emphasized through the design process are pointed out.

Keywords: hypersonic; propulsion; precooled engine; multi-cycle coupling

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Nomenclature

T	Total temperature	Subscripts:	
P	Total pressure	air	Components in opened air cycle
C_P	Specific heat	medium	Components in closed cycle
R	Gas constant	in, out	Inlet/outlet sections of Compressor/turbine
π	Pressure ratio	i, j	Tabs of components
η	Adiabatic efficiency	h	High temperature branch
Lc	Compression work	l	Low temperature branch
Lt	Expansion work	C	Compressor
θ	Mapping relation	T	turbine